Topic: Determine the possible role of galactic cosmic ray particles as a source for cloud condensation nuclei in the troposphere and lower stratosphere.

Project Title:
Modeling the consequences of realistic spatial structure of solar energy deposition into the upper atmosphere

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Project Information:
Solar EUV/XUV is the dominant heat source for the thermosphere-ionosphere system except during the rare major storms events. In the interest of computational efficiency, solar heating in thermosphere-ionosphere general circulation models (GCM) is parameterized using a heating efficiency . At any given latitude, longitude, and height, the local absorption is calculated based on the incoming solar flux spectrum, the solar zenith angle, and the species absorption cross sections. The absorption is then scaled by a globally-averaged heating efficiency to provide the local solar heating rate. A similar scheme is used for ionization and dissociation rates for a given solar spectrum.

The photochemical models used to derive heating efficiency are themselves very sophisticated, and are able to capture the consequences of variation in the efficiency due to zenith angle, ion density structure, photoelectron transport, and neutral composition, which vary greatly with latitude and local time. The GCM coupled thermosphere-ionosphere model in turn are also sophisticated and capture the neutral dynamics, energy budget, plasma processes, and electrodynamics. By using a globally-averaged heating efficiency concept much of the real structure in the photochemical models of the thermosphere-ionosphere system is lost in the GCM numerical models.

The purpose of this proposal is to move beyond the use of heating efficiencies by combining a sophisticated photochemical model with a GCM. The combination will enable the processes that are already known to introduce latitude and local time structure in the heating rates to be treated consistently and appropriately, including the structure in:

the equatorial ionization anomaly and it latitude and local time dependence,

the photoelectron heating and its local time and conjugate effects,

solar zenith angle dependence, and

seasonal/interhemispheric neutral composition.

This proposal addresses the NASA s Strategic Goal 3: Develop a balanced overall program of science, exploration, and aeronautics consistent with the redirection of the human space flight program to focus on exploration: In particular, Strategic Sub-goal 3B which is to understand the Sun and its effects on Earth and the solar system. The proposal will improve our understanding of the impact of solar EUV/XUV energetics on the thermosphere-ionosphere system. This proposal is aimed at LWS TR&T goal e) Determine and quantify the responses of atmospheric/ionospheric composition and temperature to solar XUV spectral variability and energetic particles.

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Citations: